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Relaxation of Shallow Donor Electron Spin Due to Interaction with Nuclear Spin Bath

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Abstract

We study the low-temperature dynamics of a shallow donor, e.g., 31P, impurity electron spin in silicon, interacting with the bath of nuclear spins of the 29Si isotope. For small applied magnetic fields, the electron spin relaxation is controlled by the steady-state distribution of the nuclear spins. We calculate the relaxation times T1 and T2 as functions of the external magnetic field and conclude that nuclear spins play an important role in the donor electron spin decoherence in Si:P at low magnetic fields.

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